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AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

LITHIUM HYDRIDE PROPERTIES

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METALLURGICAL PROCESSES DEVELOPMENT UNIT

March 14, 1961

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PRELIMINARY REPORT

This report is preliminary and informal in nature and was prepared for use at the Aircraft Nuclear Propulsion Department, General Electric Company in the course of work under AEC contract AT (11-1)-171, U.S. Air Force contract AF 33(038)-21102, or U.S. Air Force contract AF 33(600)-38062. Views, opinions, conclusions or proposals expressed in the report are those of the author(s) only. This report is subject to revision upon further evaluation or availability of additional data.

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The following tabulation of data presents the "best" known values for selected properties of lithium hydride determined by or for GE-ANPD, or from the referenced sources.

A. Density (solid)

<u>Temp., °C</u>	<u>g/cc</u>	<u>Reference</u>	<u>Comments</u>
Room	0.775	1, 2	Value calculated from lattice constants
200	0.757	3	Calculated for lattice constants up to 525C, estimated to 688C (solid)
400	0.733		
525	0.718		
600	0.705		
688	0.690		
580	0.703	4	Calculated from thermal expansion data

B. Density (liquid)

<u>Temp., °C</u>	<u>g/cc</u>	<u>Reference</u>	<u>Comments</u>
710	0.548	4	Measured using N.B.S. type dip cup. "Best Values"
730	0.549		
830	0.536		
945	0.496		
688	0.580	3	Estimated value

C. Melting Point

<u>Temp., °C</u>	<u>Reference</u>	<u>Comments</u>
6.86 ± 2		"Best value". GE-ANPD. Other values range from 680C to 688C.
680	5	
686.4	6	
688 ± 1	7	

D. Heat of Fusion

<u>Cal/mole</u>	<u>Reference</u>	<u>Comments</u>
7000 $\pm$ 2000	8	Estimated
5519 $\pm$ 25	9	"Best Value". Experimentally determined

E. Heat Capacity (solid)

<u>Temp., °C</u>	<u>Cal/°C/mole</u>	<u>Reference</u>	<u>Comments</u>
20	8.177	10	Estimated Values
25	8.2	7	
227	11.2 $\pm$ 0.3		
527	13.5 $\pm$ 0.7		
688	14.8 $\pm$ 1.0		
149	9.06	11	Experimentally determined using Parr adiabatic calorimeter. "Best Values"
204	9.64		
260	10.2		
315	10.7		
371	11.4		
426	11.9		
482	12.5		
538	13.1		
565	13.3		
100	8.40	9	
200	9.53		
300	10.7		
400	11.8		
500	12.9		
600	14.1		
680	15.1		

Experimentally determined using Ice calorimeter $C_p^* = 0.914 + 14.26 \times 10^{-4} t$ (100 - 680°C) "Best Values"

* Cal/°C/g

F. Heat Capacity (liquid)

<u>Temp., °C</u>	<u>Cal/°C/mole</u>	<u>Reference</u>	<u>Comments</u>
688	15.5 $\pm$ 1.0	7	Estimated
700	15.7	9	Experimentally measured using Ice calorimeter $C_p^* = 1.988 - 12.70 \times 10^{-5} t$ (700 - 900°C) "Best Values"
800	15.6		* Cal/°C/g
900	15.5		

G. Mean Linear Coefficient of Thermal Expansion
(No "best values" selected)

<u>Temp., °C</u>	<u>in/in/°C</u>	<u>Reference</u>	<u>Comments</u>
93	31.5 $\times 10^{-6}$	11	Experimentally determined on cold pressed rod from 26.8°C to indicated temperature
149	33.5		
204	37.6		

G. Mean Linear Coefficient (cont'd)

<u>Temp., °C</u>	<u>in/in/°C</u>	<u>Reference</u>	<u>Comments</u>
260	41.9		
315	45.0		
371	47.5		
426	50.0		
482	52.4		
538	52.4		
593	51.5		
648	49.5		
30-580	34.8×10^{-6}	4	Experimentally determined on cold pressed rod. Linear to intermediate temperatures.
Room-315	45.5×10^{-6}	12	Experimentally determined on cold pressed material.
100	39.8×10^{-6}	13	Calculated from lattice constants. From 20°C to indicated temperature.
200	45.0		
300	47.2		
400	49.0		
500	51.7		

H. Thermal Conductivity (solid)

<u>Temp., °C</u>	<u>Cal/sec/cm/°C</u>	<u>Reference</u>	<u>Comments</u>
50	0.0165	14	Measured in hydrogen. Cold pressed disc. Longitudinal comparative method.
100	0.0156		
150	0.0146		
200	0.0137		
250	0.0130		
300	0.0123		
350	0.0117		
400	0.0112		
450	0.0107		
500	0.0103		
550	0.0100		
600	0.0098		
50	0.0299	14	Measured in hydrogen. Crystalline disc. Longitudinal comparative method. "Best Values".
100	0.0254		
150	0.0210		
200	0.0177		
250	0.0150		
300	0.0131		
350	0.0112		
400	0.0100		
450	0.0091		
500	0.0086		
61.7	0.0175	11	Radial heat flow method. Crystalline disc.
101	0.0155		
172	0.0142		

H. Thermal Conductivity (cont'd)

<u>Temp., °C</u>	<u>Cal/sec/cm/°C</u>	<u>Reference</u>	<u>Comments</u>
236	0.0133		
266	0.0128		
304	0.0117		
352	0.0113		
408	0.0108		
449	0.0104		
513	0.0098		
64.4	0.018	4	Longitudinal comparative method. Cold pressed specimen.
96.8	0.017		
155.4	0.014		
203.7	0.014		
250.5	0.013		
300.9	0.011		
349.1	0.010		
354.2	0.011		
406.8	0.010		
654.4	0.0087	15	Method and type material unknown.

I. Thermal Conductivity (liquid)

<u>Temp., °C</u>	<u>Cal/sec/cm/°C</u>	<u>Reference</u>	<u>Comments</u>
710	0.0188	15	Method unknown.

References

1. E. Staritzky and D. I. Walker, Anal. Chem. 28, 1055 (1956).
2. E. Staritzky, D. I. Walker and F. H. Ellinger, LA-1559.
3. T. R. P. Gibb, Jr. and C. E. Messer, NYO-3957
4. GE-ANPD, determined by Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn., under development purchase order.
5. H. Tronstad and H. Wergeland, Kgl. Norske Videnskab Selskab Forh 10, No. 10, 36-39 (1937).
6. C. E. Messer and J. Mellor, NYO-8023.
7. C. E. Messer and T. R. P. Gibb, Jr. NYO-8022.

8. C. E. Messer, E. B. Damon and P. C. Maybury, NYO-3958.
9. Private communication, H. T. Kite, Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn.
10. P. Guenther, Ann Physik 63, 476 (1920).
11. I. B. Fieldhouse, J. C. Hedge and J. I. Lang, WADC-TR-58-274.
12. Reported by Pratt and Whitney ANP personnel in meeting at LAROO, March 10, 1961.
13. A. Zalkin, UCRL-4239.
14. GE-ANPD, determined by Battelle Memorial Institute, Columbus, Ohio under development Subcontract.
15. Reported by Thompson-Ramo-Woolridge personnel. Meeting at WADC, Feb. 2-3, 1961.

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